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REPORT OF THE CHEMIST.

United States Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., October 1, 1914.

Sir: I have the honor to submit herewith a brief report on the work of the Bureau of Chemistry during the fiscal year ended June 30, 1914.

Respectfully,

Carl L. Alsberg,
Chief of Bureau.

Hon. D. F. Houston,
Secretary of Agriculture.

The work of the Bureau of Chemistry, as outlined in the annual report for the year ended June 30, 1913, is distributed among three groups, designated as Regulatory, Standardizing, and Investigational. The same grouping is continued in this report for the year ended June 30, 1914.

REGULATORY WORK.

To further uniformity in the enforcement of the State and Federal food and drug laws, a meeting of State and Federal food and drug officials was held in Washington in November, 1913. At this meeting a joint committee of three members each from the Association of American Dairy, Food, and Drug Officials, the Association of Official Agricultural Chemists, and the Bureau of Chemistry of the Department of Agriculture was formed for the purpose of fixing working standards for foods and drugs. These standards should serve as a uniform guide in the enforcement of the food and drug laws throughout the country and should very largely overcome the lack of uniformity. These standards should, moreover, render food and drug control more economical and make compliance with the laws simpler. This committee has held several meetings and its work is well under way.

At the meeting of the State and Federal food and drug officials it became apparent that some central organization for the promotion of cooperation and the exchange of information would lessen the cost and increase the efficiency of administering food and drug laws by preventing duplication and by encouraging the States and the Federal Government to supplement and assist one another. The Office of State Cooperative Food and Drug Control was, therefore, established in the Bureau of Chemistry. The former Food and Drug Commissioner of Texas was placed in charge. He has already visited 35 States and has established cooperative relations which will be of great value both to the States and to the Department of Agriculture.

To increase the efficiency of the enforcement of the food and drugs act the Bureau of Chemistry was reorganized during the year. The field service of the bureau was set off from the central organization and divided into an Eastern, a Central, and a Western District, with headquarters, respectively, in Washington, Chicago, and San Francisco. A single official was placed in charge of each district. He is directly responsible to the Bureau of Chemistry for all the work in his district, so that the food and drug inspectors and the laboratories are no longer separate or independent of each other. Incident to this division of the field service of the Bureau of Chemistry, the smaller branch laboratories at Detroit, Kansas City, Omaha, Nashville, Pittsburgh, and Portland, Oreg., were closed. The control through the inspectors of food and drug products in these sections is no less thorough than heretofore. The samples are now analyzed in the larger laboratories, where this work can be done more economically.

Corresponding changes were made in the bureau organization in Washington to make it serve both as a check upon the field service and as a coordinating machine for the work of the three districts. At the same time most of the investigational work of the bureau has been concentrated in Washington, and, as far as feasible, separated from the routine work of law enforcement. It is believed that the best results can not be obtained by requiring both kinds of work from the same set of chemists.

Since January, 1914, food inspection decisions, precedents established in the bureau's policy, and notices of judgment have been published under the caption of Service and Regulatory Announcements. There thus becomes available a complete record of the regulatory activities of the Bureau of Chemistry, which should serve greatly to diminish the bureau's correspondence.

During the year the following food inspection decisions were issued:

Food Inspection Decision No. 152, defining brandy.

Food Inspection Decisions Nos. 153 and 155, announcing the department's intention on May 1, 1916, to cancel all serial numbers issued and all guaranties then on file.

Food Inspection Decisions Nos. 154 and 157, embodying the regulations for the enforcement of the net-weight amendment to the food and drugs act promulgated by the Secretaries of the Treasury, of Agriculture, and of Commerce.

Food Inspection Decision No. 156, defining wine and abrogating Food Inspection Decisions Nos. 109 and 120.

NET-WEIGHT AMENDMENT.—For establishing "tolerances and reasonable variations," as provided in the net-weight amendment to the food and drugs act, much additional material has been accumulated during the year. The Bureau of Standards of the Department of Commerce has rendered valuable assistance in studying the data collected by the field laboratories. Many hearings have been held and there has been a great deal of correspondence concerning this amendment.

INSPECTION.—Eight thousand three hundred and twenty-two official and 3,589 unofficial samples have been collected and many factory inspections have been made. The bureau has sought to broaden and extend the work of the inspectors, who, by cooperation with appropriate officials of other branches of the Government service, have attempted to control and, where circumstances warranted, to suppress altogether the traffic in certain classes of food products where there did not appear to be sufficient means to accomplish this end within the provisions of the food and drugs act. In one instance 15 indictments for conspiracy connected with the shipment of filthy, decomposed, and putrid eggs were returned. In another, largely on evidence furnished by the bureau, a conviction was secured and a long prison sentence imposed on a manufacturer of beverages containing wood alcohol. Incidentally, a number of offenses against the postal and the customs laws and the internal-revenue act have been discovered and the information furnished to the proper officials.

Importations.—Fourteen thousand two hundred and seventy-five shipments were examined and 4,524 were denied entry. In cases where misbranding could be corrected entry was permitted after the goods were properly relabeled.

It has been the practice of many importers to give bond, take possession of goods, and dispose of them before the examination by the Bureau of Chemistry has been completed. When subsequently the goods were reported to the collector as adulterated or misbranded, the importer, having disposed of the goods, was often unable to return them to the collector for relabeling or exportation. In the past, in such cases the Departments of Agriculture and the Treasury have been rather liberal in releasing the importer from the provisions of his bond. This policy has been changed, and the importers have been held to a much stricter compliance with the law.

The cooperation between the Bureau of Animal Industry and the Bureau of Chemistry with reference to domestic meats resulting from the issuance of Food Inspection Decision No. 151, covering domestic meats and meat products, has been extended to similar products offered for importation. In the past such importations were examined only by the Bureau of Chemistry. As the Bureau of Chemistry had no expert meat inspectors, its examinations were limited to the verification of the foreign meat-inspection certificates offered with the importation. This practice has been changed, and by cooperation with the Bureau of Animal Industry products subject to the meat inspection act offered for entry are examined by the meat inspectors of the Bureau of Animal Industry.

An unusually large variety of food products has been offered for entry, among which were shipments of eggs from China, butter from Australia and New Zealand, and condensed milk from Northern Europe. Many of these were trial shipments from foreign merchants.

Past experience has shown that many seeds used as drugs are offered for entry with excessive amounts of dirt, sand, and stems intermixed. It has been found, during the year, that many of these products are capable of being cleaned mechanically. It is now possible to permit their entry after such cleaning.

With the help of the Bureau of Plant Industry, which exercises control over the importation of seeds for planting, greater attention is being paid to the importation of seeds used for food and feed purposes.

To secure greater uniformity in the inspection of crude drugs offered for entry at the various ports, the Laboratory of Pharmacognosy has been established in Washington, so that the necessary examination of crude drugs may be made under the supervision of one official.

The exclusion under the Sherley amendment of medicine with false and fraudulent statements on the label has been continued, and particular attention has been paid to medicinal waters for which false and fraudulent claims are made.

Domestic foods and drugs.—The Bureau of Chemistry, under the provisions of the Sherley amendment to the food and drugs act, has paid very great attention to domestic medicines and mineral water bearing false and fraudulent labels. Many citations have been issued and a large number of cases developed. Many samples of veterinary medicines have been collected and analyzed. Where the therapeutic claims seemed false and fraudulent the information was submitted to the experts of the Bureau of Animal Industry, and upon their advice many cases have been developed. Among these preparations may be especially mentioned ineffective cures for hog cholera. The position long held by the bureau that water to be properly labeled lithia water should contain enough lithia to produce the therapeutic effect of lithium compounds has been sustained by the Supreme Court of the District of Columbia. Action has been taken in accordance with this opinion. A warning has been issued regarding the use of so-called radioactive waters that contain insufficient radium to be of therapeutic value, and measures are being taken to prevent their exploitation. In consequence of the bureau's action, mineral waters sold as "natural," but which, in fact, contain added carbonic-acid gas or mineral salt, are now properly labeled.

To many wines carbonic-acid gas is, similarly, added for the purpose of simulating a bottle-fermented wine such as champagne or sparkling Burgundy. To discover by examination whether a wine has been artificially carbonated, or is bottle-fermented, or whether a malt liquor has been artificially carbonated, or "kräusered," has been difficult. A method for the detection of artificial carbonation has been developed which is now being tried in practice. Incidentally, observations have been made which may lead to the improvement of the methods of artificial carbonation.

As a part of the work of the Bureau of Chemistry, seeking to maintain the standards of the United States Pharmacopœia in medicinal preparations, a complete study of certain simple household remedies was made from every pharmacy in the District of Columbia. Much carelessness in compounding by retail pharmacists was discovered. Except in the District of Columbia and the Territories, this type of control devolves upon the State, and not upon the Federal Government. It was undertaken by the bureau in the District of Columbia not merely to protect the consumer within the District, but, also, for the purpose of bringing to the attention of State officials the condition of simple preparations as often dispensed by the pharmacist.

Pollution of food products.—Quite as important as holding drug products to the official standards is the protection of the consumer from pollution of foods and beverages. Such pollution may lead to serious epidemics. The policy with reference to milk, outlined in the report for 1913, has been continued. A new development of this policy was begun at Pittsburgh, Pa. Through a joint conference with the shippers and the railroads, and making use of a recent opinion of the Interstate Commerce Commission, it has been possible to adjust conditions so that, practically, all of the milk shipped into Pittsburgh is refrigerated in transit.

In conjunction with the Public Health Service, and with the assistance of the Bureau of Fisheries of the Department of Commerce, which furnished its steamship *Fish Hawk*, a sanitary survey of the oyster beds of Chesapeake Bay was undertaken. A similar survey was undertaken, independently, in Jamaica Bay, N. Y. Sources of pollution and polluted areas were thus located. Oystermen, when such places are pointed out, transplant their shellfish for a suitable period in unpolluted waters, and, consequently, are able to furnish unpolluted oysters without sacrificing valuable food material.

Canned goods.—Opinions, based upon experiments, have been published concerning the quantity of oysters, clams, and shrimps that should be placed in a can of given size. These opinions are used as a guide by packers and food officials and are leading to the proper filling of containers. A serious abuse still exists in canning tomatoes, the cans being filled partly with tomatoes and partly with water. Methods for the detection of the practice are being studied. The investigation of the deterioration of canned goods, through the solution of tin from the tin plate of the container, has been continued. An opinion based on investigations completed last year, condemning the use of cull beans in canned baked beans, has been issued, and has been supplemented by seizure of such beans en route to the canneries.

Flour and feed.—The practice of making macaroni and similar alimentary pastes from wheats not suited to this purpose has led to the artificial coloring of such products in imitation of products made from suitable wheats, such as durum. The Bureau of Chemistry has proceeded against such products, many of which, besides being artificially colored, are sold under labels so like those found on imported goods as to prove most deceptive. Studies have also been made upon the influence of stacking and shocking wheat on the quality of flour produced therefrom and the kind of bread made from the flour.

The effects of the action of the Bureau of Chemistry with reference to flour-mill by-products are becoming apparent. Fewer feeds than formerly are now found below the guaranty in protein and fat and above the guaranty in fiber. Moreover, the variations from the published guaranty are also smaller. The practice of adding sand to stock feeds has been almost completely eliminated. The addition of screenings to mill by-product feeds without declaration on the label is not to-day a matter of frequent occurrence. A large amount of work has been done upon establishing standards for various mill by-products and similar feeds.

STANDARDIZING WORK.

The Contracts Laboratory, in which much of the examination of samples of materials for contract supplies was done, has been transferred to the Bureau of Standards of the Department of Commerce. The examination of food and drug products for other branches of the Government service continues in the Bureau of Chemistry.

Naval stores.—The development of permanent and standard type samples of rosin and turpentine was made necessary by the fact that no authoritative standards existed for these articles, which are produced annually to the value of about $50,000,000. The possibilities of misgrading are very great, and the loss of money both to the producer and to the buyer may be considerable. After several years' study, permanent type samples have been devised. These have been submitted at a meeting of naval-stores interests and approved. They are at present undergoing the test of practice at the chief naval-stores centers.

INVESTIGATIONAL WORK.

Vegetable and fruit utilization.—Among the great difficulties with which practical agriculture has to deal are not merely fluctuation of production, which swings from overproduction in good years to underproduction in bad ones, but also deterioration of agricultural products, due to their perishable nature. Agriculture will benefit greatly from any means which can be devised to utilize surplus when production is abundant and to convert perishable products into stable ones that can be carried over from periods of plenty to those of scarcity. The Bureau of Chemistry is paying attention to a number of methods to accomplish this end. Among these may be mentioned the application of cold storage to such products as poultry and eggs, the development of industries based upon agricultural waste products, such as cull fruit and cull potatoes, and the drying of agricultural products to render them nonperishable and cheaper to transport. The drying of agricultural products is certain in the near future to prove most important in the marketing of such products.

The study of the utilization of surplus and cull potatoes, which has been in progress for some time in collaboration with the Bureau of Plant Industry, has been greatly extended. For the present the work is confined to potato drying and starch manufacture. Dried potatoes can be kept indefinitely for stock food and may be far more cheaply transported, since the fresh potato may contain as much as 80 per cent of water. It is proposed ultimately to extend these investigations to the production of potato dextrin and potato glucose, as well as potato starch, all of which have advantages for certain manufacturing purposes over other starches and starch products. The object is to encourage the production of potatoes as a regular part of crop rotation in certain sections where this form of agriculture seems advantageous. Such progress has been made that during the coming year work will be conducted on a small commercial scale.

The study of cull lemons and oranges has continued at Los Angeles upon a small commercial scale. The study of the manufacture of citric acid is nearly completed and the study of the production of lemon oil will probably be completed in the course of the coming year. In addition, the composition of oranges in the course of the ripening season in various localities of California has been studied in order to obtain information for use in the control of the shipping of immature fruit which has been colored by sweating.

In studying grape products it was found that for the storage of different types of grape juice, at freezing temperatures, vats can be substituted for carboys. However, this treatment somewhat changes the character of the juice, owing to the separation of crude cream of tartar. Grape sirups were found to be easily prepared from grape juice by liming and concentration by evaporation.

The Enological Laboratory, maintained at Charlottesville, Va., for the purpose of studying the manufacture of wines and similar fruit products, has been closed. Such work on wines and alcoholic beverages as may be necessary in connection with the enforcement of the food and drugs act will be done in Washington.

From surplus and cull apples two products have been made which promise to be of commercial importance. These are concentrated cider and cider sirup. For the manufacture of concentrated cider the apple juice is frozen solid, the block of ice is crushed, and the crushed ice is introduced into a centrifugal machine which removes the concentrated cider, leaving the ice behind. In this way a concentrated cider is obtained which, when diluted with water, has practically the flavor and qualities of the original apple juice from which it was made. The concentrated cider ferments very slowly at refrigerator temperatures, but at room temperatures fermentation occurs after a few weeks. This is a good example of rendering a very perishable agricultural product both stable and much cheaper to transport. Such concentrated cider can be transported relatively cheaply to great distances and kept in cold storage for long periods. The cider sirup is prepared by clarifying and boiling down apple juice and promises to be of some value as a table sirup.

JAMS, JELLIES, AND PRESERVES.—Manufacturers of jams, jellies, and preserves have great difficulty in making a uniform product. The difficulties in obtaining a product of the proper consistency, and in preventing it from granulating through the crystallization of cane sugar, are great. The methods of the manufacturers are largely methods of trial and failure. No definite rules seem to exist which manufacturers can use as a guide in judging the proper amount of sugar to be added or the length of time the product must be boiled. In fact, so far as appears in published records, the manufacture of these products does not seem to have been made the subject of scientific investigations. As it seems probable that the application of well-known principles of chemistry will greatly improve the methods of production, investigation of the processes of manufacture of jams, jellies, and preserves has been undertaken. For example, methods for preparing grape-fruit and orange marmalades for the market are being studied. There can be no doubt that if it proves possible to put the manufacture of such products upon a scientific basis much wasted fruit will be utilized. At the same time, in the course of these investigations, valuable information for use in the enforcement of the food and drugs act is being obtained.

CANDY.—The principles of candy manufacture are perhaps in the same unsatisfactory state as those of jams, jellies, and preserves. The books on the manufacture of candy are largely composed of recipes such as are found in cookbooks. Little or nothing is said concerning the principles that underlie the manufacture of candies. Such questions as the means of preventing the granulating of candy, which causes it to be rejected by the consumer as "stale," or the prevention of the softening of the candy, which makes it unmerchantable, because it becomes sticky, do not seem to be understood. These also seem to be difficulties that can be controlled by the application of well-known scientific principles. Accordingly, chemical investigations of the principles of candy manufacture are being made for the purpose of aiding factory practices.

Sugar.—The suitability of many varieties of granulated sugar for the manufacture of transparent hard candy has been studied. A wide variation in quality has been observed. Some sugars, classed as standard granulated, darken when made into candy. A test referring to color and transparency of the product has been devised for the determination of the suitability of a sugar for making a hard candy.

Cane sugar, sirup, and molasses.—One of the difficulties in the manufacture of cane sirup is to inhibit the granulation due to the crystallization of cane sugar. It has been found that by the use of the yeast ferment invertase this granulation can be avoided. A method for the preparation of invertase for this purpose has been devised. Methods also have been perfected for readily preparing in quantity in a state of purity a number of sugars. Samples of some of these have been supplied to several bacteriologists for use in investigation of problems concerning public health.

Several studies on the physical and chemical constants of pure carbohydrates have been made.

Fish.—With the growing scarcity of meat, fish and other sea foods must more and more be utilized to supply the necessary nitrogenous elements of the diet. Unlike the meat-packing industry, the sea-food industry has not to any considerable degree been made the subject of scientific investigations. Storage, transportation, prevention of waste, and the utilization of by-products are not so well understood in the sea-food industry as in other industries that deal with perishable products. There can be no doubt that investigations in this industry will be as valuable as they have proved in the meat-packing industry or in the transportation of fruit. Studies of the utilization of wastes from fisheries have heretofore been confined largely to the manufacture of fertilizers, fish oils, and glue. They have not tended to conserve the food supply. Careful studies of the best methods of conserving and utilizing fishery wastes are so necessary that an investigation of these questions has been undertaken, in cooperation with the Bureau of Fisheries of the Department of Commerce. During the year the basis has been laid for studies of this kind, which should be of great service in connection with the food supply.

The industry of canning sardines on the Maine coast has received special attention. A temporary laboratory was installed, and investigations were conducted for the purpose of improving the quality of the product and the conditions under which it is prepared. As a result of this work a marked improvement of the sanitary conditions under which sardines are packed is already noticeable.

Poultry and eggs.—The demonstration of improved methods of packing, refrigerating, and shipping poultry has been continued in the producing section. In consequence the installation of mechanical refrigeration, especially in Missouri, is increasing. A system for the management of egg-breaking plants has been developed, with the result that for a given plant the number of employees is reduced one-third, the output is increased, and the quality improved. The demonstration of this system has resulted in the equipment of a number of model egg-breaking establishments in New York, Pennsylvania, Missouri, Ohio, Minnesota, and Indiana, while plans have already been made for a number of others. The best methods for freezing and drying eggs and their use by bakers and others have been studied. The breakage of eggs in transit has been investigated, in order to devise a means to reduce the tremendous losses resulting from this cause. An instrument to register shocks received by eggs while in transit has been produced. Tests have been made of commercial egg packages, in order that the best method of packing eggs may be discovered. This work has been done in cooperation with packing houses, railroads, and refrigerator car lines. The results obtained should be of great value in lessening breakage.

WHEAT AND GRAINS.—The results of investigations to determine the influence of environment on the composition of wheat and other grains seem to indicate that climate is the determining factor in the composition of the crop. The grain grown in one locality from seeds from various localities was found to be identical in appearance and composition. The manufacture of macaroni from domestic durum and semolina has been studied. In order to determine the variety of wheat best adapted for a particular locality, milling and baking experiments have been conducted in collaboration with the Bureau of Plant Industry. Experiments also have been conducted on flour mixtures containing substitutes for wheat. Thus, for example, bread has been made from a mixture of 1 part of kafir or milo and 3 parts of flour. Other mixtures studied contained rye, oats, barley, corn, rice, cottonseed meal, soy beans, acorns, banana, or chestnuts.

PHARMACOLOGICAL INVESTIGATIONS.—Studies upon the toxicity of sodium tartrate and on the pharmacology of tin and zinc have been made. Further investigations upon the action of caffein also have been made.

INSECTICIDES AND FUNGICIDES.—Experimental work concerning the injury to fruit trees by poisonous sprays through the medium of the soil has been completed. Study of the preparation of ortho and pyro arsenates of lead is in progress.

In cooperation with the Bureau of Entomology and the Bureau of Plant Industry, an investigation was conducted to discover means to prevent the breeding of the house fly in manure and at the same time to preserve the agricultural value of the manure. It was found that borax properly used prevents the breeding of flies and in no way alters the value of the manure for agricultural purposes.

UTILIZATION OF WOOD WASTES.—The industrial experiments in wood distillation described in the report for 1913 were concluded. Analyses of the products, with calculations of cost of extraction of the separate products, were made. In collaboration with the University of Idaho at Moscow, experiments have been undertaken on the utilization of the products that may be obtained by distilling stumps and waste material on cleared land.

PAPER INVESTIGATIONS.—Proper methods for testing durability of paper are of the greatest importance to manufacturers and to purchasers of paper, of whom the Federal Government is one of the largest. The degree to which humidity affects the testing of paper has been found to be such that no correction for the error due to varying conditions of humidity can be applied. The deterioration of paper was studied by estimating the effect of increase of temperature on folding. Durability of various pulps was also studied, with the result that laboratory tests were found to be in accord with experience in proving that papers from ground wood lack durability. An attempt is being made to learn what materials and what processes of manufacture secure the most serviceable sort of blotting paper.

With the cooperation of the Bureau of Standards of the Department of Commerce and of the Bureau of Engraving and Printing of the Treasury Department, a search has been made for an inexpensive paper of improved quality for use as paper currency. The aim is to secure such a paper that counterfeiting will be rendered difficult.

Leather investigations.—The machine designed for the purpose of testing the wearing quality of leather under conditions closely resembling actual service, mentioned in the report for 1913, has been used in testing leathers prepared from different parts of a number of animals. Studies of the action of varying amounts of sulphuric acid on the durability of leathers and of the utilization of tannery wastes as fertilizers are in progress.

Drug products.—Investigations upon spirits of nitrous ether, aromatic spirits of ammonia, ascaridolic acid, santonin, thujone, paregoric, and dentifrices have been made.

Analytical methods.—In connection with the enforcement of the food and drugs act and various other kinds of work, a number of analytical methods have been studied, including methods for the determination of citric acid; acetanilid and antipyrine in headache mixtures; nitroglycerine in tablets; papain; pepsin; and certain of the heavy metals occurring in insecticide and fungicide preparations. Some of this work has been done in cooperation with the Association of Official Agricultural Chemists.

A study of methods for the determination of lactose and maltose in the presence of other sugars has been begun. Honey has been analyzed to detect the presence of added cane sugar and glucose. Methods for the examination of turpentine, rosin, and wood products have been devised. Owing to the introduction of the hand separator, much cream is being shipped great distances for the manufacture of butter. This cream is often excessively acid, or fermented. In order to manufacture butter from it the acidity of the cream is neutralized with alkali. The recognition of butter made in this way has proved difficult. Therefore, methods of determining whether or not a given sample of butter was made from neutralized cream have been investigated. The study of the clarifying of leather extracts for the determination of sugar has been completed. The determination of free mineral acids in leather which injure its durability also has been investigated. In judging the quality of a leather it is often necessary to be able to determine the material with which it was tanned. The methods of making such a determination are not satisfactory in all respects, and much work has been done in perfecting them.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1914